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(71) Applicant
Accumlatori Industriali Fiamm S p A (Italy),
Via Dovaro 8, 36045 Almisano, Lanigo (Vicenza), Italy

(72) Inventor
Mario Chilese

(74) Agent and/or Address for Service
Barlin Professional Services,
Barlin House, 20 High Street, Carshalton, Surrey
SM5 3AG

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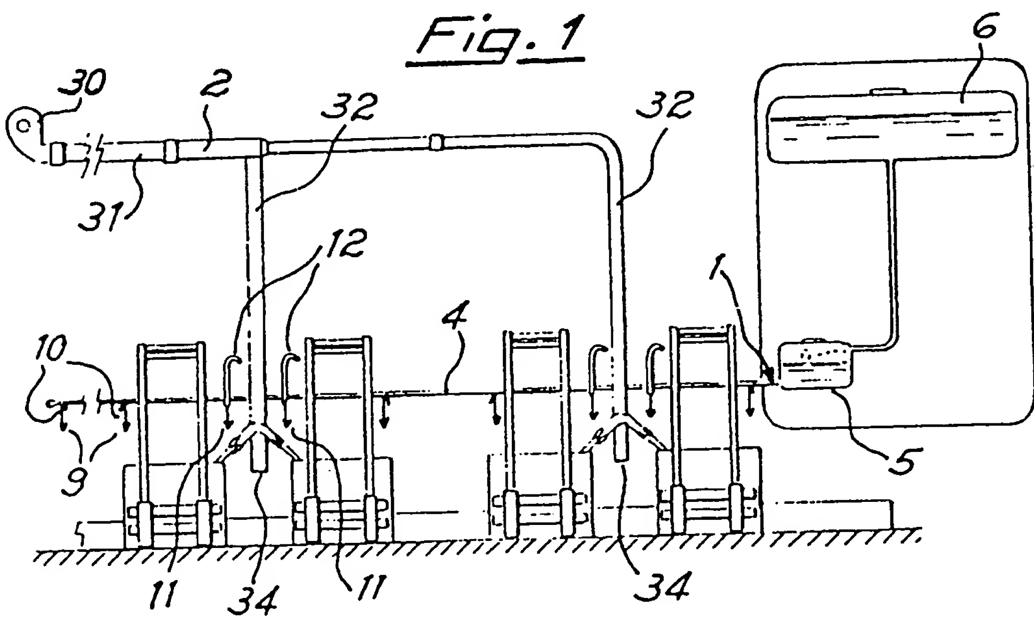
(54) **Battery top-up and venting device**

(57) A charging station for traction batteries comprising a topping-up device (1) for distilled water and means (2) for suction of the gases developed through the piping which connects batteries to automatic level control devices.

Fig. 1



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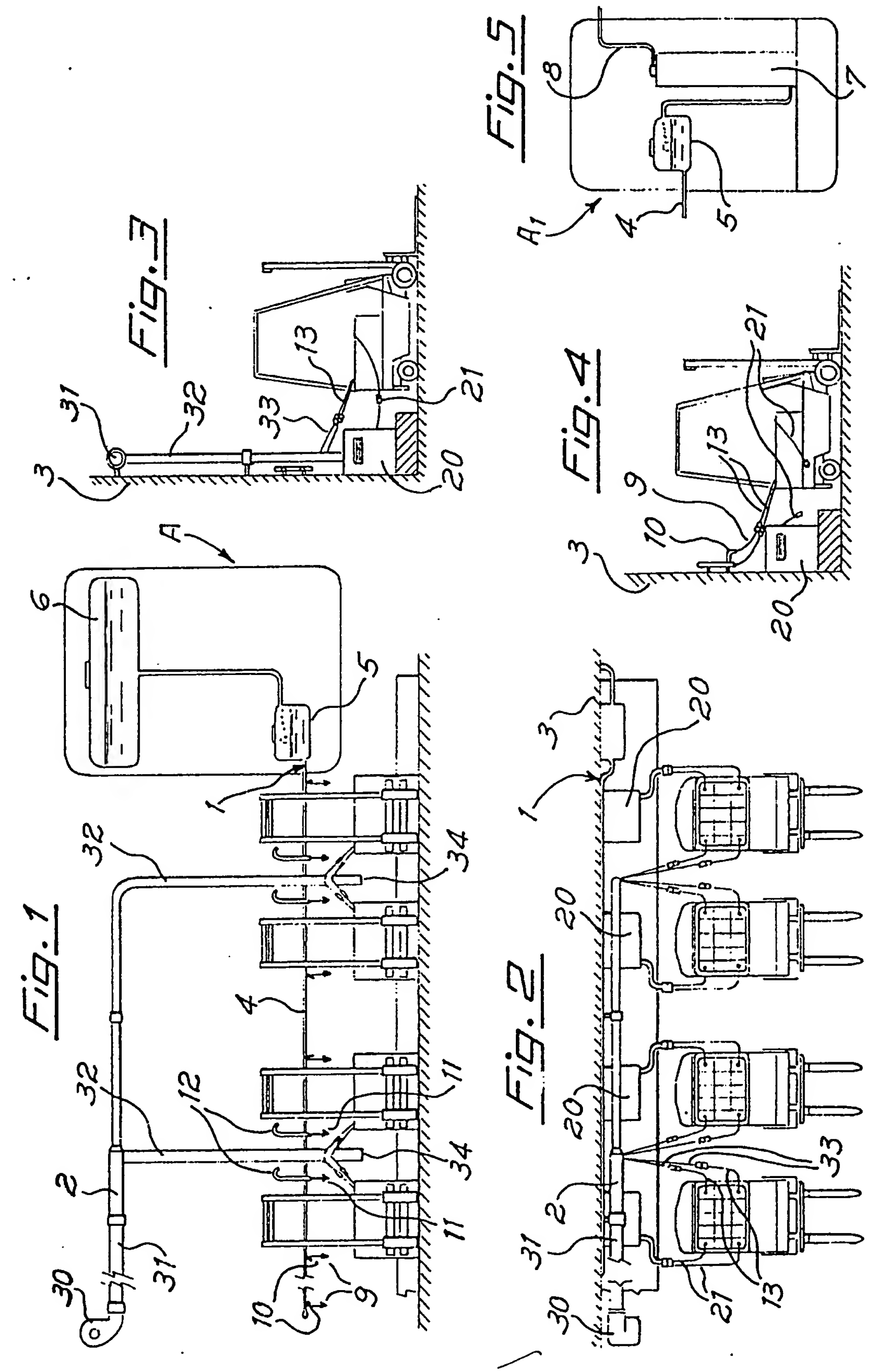

SPECIFICATION

Charging station for traction batteries with centralised individual or multiple topping up and complete venting of charging gases

It is known that electric batteries that power transporter, or forklift trucks, or any autonomous electric vehicle must be recharged whenever the electro-chemical energy stored and used as mechanical traction energy runs down. The recharging operation of this energy in the battery is always performed with an efficiency of less than unity with the consequent electrolysis of the water due to passive reactions and water consumption, either due to the above mentioned electrolytic decomposition, or by evaporation, or entrainment by the gases formed.

It is also known that the electrolyte of the batteries must maintain the correct level and density to assure proper operation and an acceptable working life.

It is also known that the gases which are formed as a result of the decrease in efficiency, particularly at the end of the charge and when over-charging are hydrogen and oxygen, and that their mixture, or the mixture of the former with air are highly explosive. In view of the above, in the management of traction batteries the two operations of topping up with distilled water and the removal of explosive gases from the atmosphere are necessary. To-date topping up has been performed with manual and single operations per element, hence encountering considerable difficulties both technical, to ensure correct operation, and economic due to the time required.

For this purpose numerous automatic topping up systems have been realised with mechanical, pneumatic, or physical interventions.

In particular, automatic topping up devices have been developed to exploit the valve effect of the surface tension of the water descending from calibrated holes under a slight reduced pressure and under a slightly increased pressure condition.

This is the characteristic of the system described in Italian patent No. 23228 A/82 and in the design No. 22849 B/82 on behalf of F.I.A.M.M., in which, besides the said technical arrangement made element by element, also the connection between the various elements has been realised so that the topping up service becomes automatic and centralised through one, or more tubes fitted with explosion-proof safety devices at the end, to be applied when charging has been completed. When the automatic centralised topping up operation is performed under a slightly reduced pressure it is also necessary to protect the suction equipment from the accumulation of explosive gases.

However, generally, all systems protect the batteries as the source of maximum risk, but discharge gases that may form explosive mixtures into the atmosphere. For this reason it is necessary to purge the atmosphere in which the charging operation occurs, to avoid the ignition of explosions outside the battery itself.

Standards are foreseen for this purpose which prescribe a minimum ventilation to be assured in recharging atmospheres. For example, the CEI 21,5 Standard, 1969 edition in section 2–5.2.03 prescribes that "the quantity of air to be continuously changed in a battery room during the charging operation to avoid the danger of formation of explosive mixtures of hydrogen and oxygen, is calculated with the following formula:

$$P = \frac{Ins}{5000}$$

where P = flow rate of air in m^3/minute; I = charging current in ampere; n = number of elements; S = safety coefficient which is considered equal to 5 for normal sized premises and equal to 10 in special premises".

The above assumes a regular hydrogen distribution in the room to be purged and complete efficiency of the ventilation means during the charging operation.

Both conditions may not be satisfied with a consequent serious risk. Furthermore, the loss of minimum quantities of sulphuric acid carried as an aerosol by the gases even beyond the filtering devices, cause considerable corrosion possibilities in the battery room, that have frequently lead to a negative appraisal of the conditions of electric forklift trucks in favour of diesel powered forklift trucks in contrast with every real scientific basis, because carbon dioxide, or carbon monoxide are feared less than sulphur trioxide.

To render the service of batteries for electric vehicles safer, in particular that of transporter, or forklift trucks, this design combines in a single complex, the centralised topping up device particularly the gravity feed version with a surface-active valve effect type venting device of the charging gases directly on each individual element making use of the supply channels for the topping up water.

Individual suction systems on elements for underwater traction were already known for the construction of batteries for submarines, where the discharge gases were vented together with a given quantity of additional air, to achieve a correct purge of all the elements.

In this design venting of the gases may occur directly from the two ends of the distilled water channels, diluting them in the suction air upstream of the said end.

It is also possible to effect drainage with partial dilution by causing a small ventilation current to pass through the supply channel, the inlet being at one end and the outlet at

the opposite end towards the ventilation device.

The choice of the system depends mainly on the size of the battery, because the dilution system through the elements causes a slightly greater evaporation of the water, but precisely by this mechanism it ensures a greater cooling of the battery particularly in the case of large size batteries. To make both the composition and the operation of the device clearer an illustrative and non-limitative embodiment is detailed making use of the attached drawings where:

Figure 1 represents in schematic elevation a device to top up and vent four forklift trucks;

Figure 2 represents the same device in plan view;

Figure 3 represents a side view of the connected device during the suction and venting phase;

Figure 4 represents a side view of the connected device during the topping up phase;

Figure 5 represents a variant of the topping up system with a direct connection to the water network.

As can be seen in Figs. 1 and 2 the charging station, according to the design, includes a topping up device 1 and a ventilation device 2 generally arranged and supported against a wall 3, the charging station being naturally equipped with suitable rectifiers 20, not represented here in detail because they are known items and do not influence this design.

Figs. 1 and 2, by way of example, represent four forklift trucks that have been driven beneath the charging station after their operation, but their number has no influence on the design, since the design can be prearranged for a single bay to any multiple thereof.

The topping up system and the ventilation system terminate with their derivations at a level slightly higher than the usual height of the forklift trucks to be charged, with flexible connecting elements, which compensate the small quota differences that vary from one model to another.

In Fig. 1 and in Fig. 4 however the topping up system can be seen consisting of a horizontal pipe 4 at a height of approximately 400–700 mm. above the maximum height of the battery and connected to a supply tank 5, equipped with a float which allows the topping up water to be drawn from the reserve tank 6 that makes up the supply unit A.

As an alternative to this system that has a limited autonomy, instead of arrangement A, a continuous supply means A' connected with the water network (as can be seen in Fig. 5) can be applied, where the supply tank 5 is connected via the demineralisation column 7, suitably renewable to the pipe of the potable water network 8.

However, with one of the devices distilled, or demineralised water is supplied to the horizontal pipes 4, from which numerous tubes 8 branch-off fitted with a valve 10 and a rapid connector, complementary to the one installed at one end of the battery tube.

A second end of the pipe is coupled to a second series of tubes 11 connected to a vent line 12, which rises to a level higher than the tank 5.

When preferably at the end of the charging operation, the circuit is connected up in the above mentioned manner, and the valves 10 are opened, a slight pressure is applied to the water pipe which forces the water to enter the batteries until the mechanism, preferably surface-active valve effect type according to the patent mentioned, define the correct and general topping up of the elements.

In the phase which is not that of topping up, but of charging or of rest, the batteries are connected electrically to the rectifiers 20 via the usual cables 21 delivering the appropriate charging currents. However it is essential that, before the switches are closed, the duct pipes of the batteries are connected to the suction systems 2, as detailed in Figs. 1, 2 and 3.

The suction system 2 equipped with an acid-proof and explosion-proof fan 30, controlled by a control device not represented here, the closure of which is essential to supply voltage to the rectifiers, via the acid-proof tubes 31 and the various down-lines 32 with the flexibles 33, is capable of absorbing the air corresponding to the ventilation prescribed by the safety standards mentioned.

The down-lines 32, generally one for every two batteries, are connected via the flexibles 33 with the usual rapid connectors, to the ends of the supply and topping up channels of the batteries 31 hence all the gases developed in the elements are sucked into the tubes 31 by the fan 30. In order not to form excessive depressions each down-line is opened at 34 with a calibrated hole which maintains the depression at a limit not exceeding 0,1 Kg/cm^2. Alternatively, when it is desired to improve cooling of the battery, it is possible to connect only one end of the pipes 13 and 33, leaving the other end of the pipe 13 fitted with an explosion-proof filter.

In this way, air is sucked through the elements through this free end draining off the charging gases mixed with it. From the descriptions provided it is clear that a charging station, according to the design claimed, assures the simultaneous perfect topping up of all the elements of all the batteries without acid, or water losses and purging of everything that represents an explosion, of pollution risk, without any gas, or acid mist dispersion in the atmosphere. The automated topping up system described with the valve effect of the surface tension of the water is the

preferred solution, but another device can also be applied in the system without the claimed design becoming superceded.

CLAIMS

1. Charging station, mainly for traction batteries characterised by being fitted in proximity to the rectifier system with a double topping up device for the distilled water and suction of the gases developed during the charging, or rest phase, through the piping which connects the automatic centralised level control devices.

2. Charging station, according to claim 1, wherein the topping up device consists of a distribution channel with numerous down-lines corresponding to the number of batteries, each complete of automatic connectos on one end for the above mentioned channelling and a second end with numerous discharge and level tubes, the latter being determined by a float operated supply tank downstream of a reserve tank, or of a demineraliser strainer connected directly to the network.

3. Charging station, according to claim 1, wherein the charging gas purging system is derived directly from the battery by the insertion of various down-lines with flexible connections, connectable to one, or both ends of the channel which connects the automatic level control devices, the second end of the said channel remaining free, fitted with an explosion-proof filter device.

4. Charging station, according to claim 1, wherein the voltage to the rectifiers is only supplied after closure of the suction supply circuit has been effected.

5. Charging station according to claim 1, wherein the said suction system assures a flow rate as prescribed by the CEI Standards to protect the room and that the lower ends of the suction system remain open in order to maintain a reduced pressure inside the battery lying between 0,01 and 0,1 Kg/cm^2.

6. A battery charging station substantially as described herein with reference to or as illustrated in the accompanying drawings.

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